**T08D11 – Acid Base Topic SL Exam**

**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**1.** Four aqueous solutions, I, II, III and IV, are listed below.

I. 0.100 mol dm–3 HCl

II. 0.010 mol dm–3 HCl

III. 0.100 mol dm–3 NaOH

IV. 0.010 mol dm–3 NaOH

What is the correct order of **increasing** pH of these solutions?

A. I, II, III, IV

B. I, II, IV, III

C. II, I, III, IV

D. II, I, IV, III

**2.** Which methods will distinguish between equimolar solutions of a strong base and a strong acid?

I. Add magnesium to each solution and look for the formation of gas bubbles.

II. Add aqueous sodium hydroxide to each solution and measure the temperature change.

III. Use each solution in a circuit with a battery and lamp and see how bright the lamp glows.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**3.** Which **one** of the following species can act as both a Brønsted-Lowry acid and base in aqueous solution?

A. CH3COOH

B. NO3–

C. H2PO4–

D. OH–

**4.** An aqueous solution of which of the following reacts with magnesium metal?

A. Ammonia

B. Hydrogen chloride

C. Potassium hydroxide

D. Sodium hydrogencarbonate

**5.** Which is a conjugate acid-base pair in the following reaction?

HNO3 + H2SO4  H2NO3+ + HSO4–

A. HNO3 and H2SO4

B. HNO3 and H2NO3+

C. HNO3 and HSO4–

D. H2NO3+ and HSO4–

**6.** The equation for the reaction between nitric acid and sulfuric acid is shown below.

H2SO4 + HNO3  H2NO3+ + HSO4–

Which species are acting as acids in this reaction according to the Brønsted-Lowry theory?

A. H2SO4 and HNO3

B. H2SO4 and H2NO3+

C. HNO3 and H2NO3+

D. H2NO3+ and HSO4–

**7.** Which of the following is/are formed when a metal oxide reacts with a dilute acid?

I. A metal salt

II. Water

III. Hydrogen gas

A. I only

B. I and II only

C. II and III only

D. I, II and III

**8.** The pH of a solution is 2. If its pH is increased to 6, how many times greater is the [H+] of the original solution?

A. 3

B. 4

C. 1000

D. 10 000

**9.** Which equation represents an acid-base reaction according to the Lewis theory **but not** according to the Brønsted-Lowry theory?

A. CO32–(aq) + 2H+(aq) → H2O(l) + CO2(g)

B. Cu2+(aq) + 4NH3(aq) → CU(NH3)42+(aq)

C. BaO(s) + H2O(l) → Ba2+(aq) + 2OH–(aq)

D. NH3(g) + HCl(g) → NH4Cl(s)

**10.** Lime was added to a sample of soil and the pH changed from 4 to 6. What was the corresponding change in the hydrogen ion concentration?

A. increased by a factor of 2

B. increased by a factor of 100

C. decreased by a factor of 2

D. decreased by a factor of 100

**11.** Which substance can be dissolved in water to give a 0.1 mol dm–3 solution with a high pH and a high electrical conductivity?

A. HCl

B. NaCl

C. NH3

D. NaOH

**12.** In which reaction is H2PO4–(aq) acting as a Brønsted-Lowry base?

A. H2PO4–(aq) + NH3(aq) → HPO42–(aq) + NH4+(aq)

B. H2PO4–(aq) + OH–(aq) → HPO42–(aq) + H2O(l)

C. H2PO4–(aq) + C2H5NH2(aq) → HPO42–(aq) + C2H5NH3+(aq)

D. H2PO4–(aq) + CH3COOH(aq) → H3PO4(aq) + CH3COO–(aq)

**13.** The pH of solution **X** is 1 and that of **Y** is 2. Which statement is correct about the hydrogen ion concentrations in the two solutions?

A. [H+] in **X** is half that in **Y**.

B. [H+] in **X** is twice that in **Y**.

C. [H+] in **X** is one tenth of that in **Y**.

D. [H+] in **X** is ten times that in **Y**.

**14.** When the following 1.0 mol dm–3 solutions are listed in increasing order of pH (lowest first), what is the correct order?

A. HNO3 <H2 CO3 < NH3 < Ba(OH)2

B. NH3 < Ba (OH)2 < H2 CO3 < HNO3

C. Ba (OH)2 < H2 CO3 < NH3 < HNO3

D. HNO3 < H2 CO3 < Ba (OH)2 < NH3

**~~15.~~** ~~Which substance, when dissolved in water, to give a 0.1 mol dm–3 solution, has the highest pH?~~

~~A. HCl~~

~~B. NaCl~~

~~C. NH3~~ This question is a repeat by mistake – FREEBIE!!

~~D. NaOH~~

**16.** Lime is added to a lake to neutralize the effects of acid rain. The pH value of the lake water rises from 4 to 7. What is the change in concentration of H+ ions in the lake water?

A. An increase by a factor of 3

B. An increase by a factor of 1000

C. A decrease by a factor of 3

D. A decrease by a factor of 1000

**17.** Which change in [H+] causes the biggest increase in pH?

A. A change in [H+(aq)] from 1×10–3 to 1×10–2 mol dm–3

B. A change in [H+(aq)] from 1×10–3 to 1×10–4 mol dm–3

C. A change in [H+(aq)] from 1×10–4 to 1×10–2 mol dm–3

D. A change in [H+(aq)] from 1×10–4 to 1×10–6 mol dm–3

**18.** Which methods can distinguish between solutions of a strong monoprotic acid and a weak monoprotic acid of the same concentration?

I. Add magnesium to each solution and measure the rate of the formation of gas bubbles.

II. Add aqueous sodium hydroxide to each solution and measure the temperature change.

III. Use each solution in a circuit with a battery and lamp and see how bright the lamp glows.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**19.** Which species are a conjugate pair according to the Brønsted-Lowry theory?

A. CH3COOH and CH3CHO

B. NH3 and BF3

C. H2NO3+ and NO3–

D. H2SO4 and HSO4–

**20.** Which is **not** a strong acid?

A. Nitric acid

B. Sulfuric acid

C. Carbonic acid

D. Hydrochloric acid

**21.** Which is a Brønsted-Lowry acid-base pair?

A. H2O and O2–

B. CH3COOH and CH3COO–

C. NH4+ and NH2–

D. H2SO4 and SO42–

**22.** Which species can act as a Lewis acid?

A. BF3

B. OH–

C. H2O

D. NH3

**23.** What is the conjugate base of the HSO4–(aq) ion?

A. H2SO4(aq)

B. SO42–(aq)

C. H2O(l)

D. H3O+(aq)

**24.** The pH of a solution changes from pH = 1 to pH = 3. What happens to the [H+] during this pH change?

A. It increases by a factor of 100.

B. It decreases by a factor of 100.

C. It increases by a factor of 1000.

D. It decreases by a factor of 1000.

**25.** Which acids are strong?

I. HCl(aq)

II. HNO3(aq)

III. H2SO4(aq)

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**26.** Solutions of hydrochloric acid (HCl(aq)) and ethanoic acid (CH3COOH(aq)) of the same concentration reacted completely with 5.0 g of calcium carbonate in separate containers. Which statement is correct?

A. CH3COOH(aq) reacted slower because it has a lower pH than HCl(aq).

B. A smaller volume of CO2(g) was produced with CH3COOH(aq) than with HCl(aq).

C. A greater volume of CO2(g) was produced with CH3COOH(aq) than with HCl(aq).

D. The same volume of CO2(g) was produced with both CH3COOH(aq) and HCl(aq).

**27.** (a) (i) A solution of hydrochloric acid has a concentration of 0.10 mol dm–3 and a pH value of 1. The solution is diluted by a factor of 100. Determine the concentration of the acid **and** the pH value in the diluted solution.

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(2)

(ii) Explain why 0.10 mol dm–3 ethanoic acid solution and the diluted solution in (a) (i) have similar [H+] values.

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(b) Suggest **one** method, other than measuring pH, which could be used to distinguish between solutions of a strong acid and a weak acid of the same concentration. State the expected results.

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(Total 7 marks)

**28.** Vinegar has a pH of approximately 3 and some detergents have a pH of approximately 8. State and explain which of these has the higher concentration of H+ and by what factor.

(Total 1 mark)

**29.** The equilibrium reached when ethanoic acid is added to water can be represented by the following equation:

CH3COOH(l) + H2O(l)  CH3COO–(aq)+H3O+(aq)

Define the terms Brønsted-Lowry acid and Lewis base, and identify two examples of each of these species in the equation.

(Total 4 marks)

**30.** The pH values of solutions of three organic acids of the same concentration were measured.

acid X pH = 5

acid Y pH = 2

acid Z pH = 3

(i) Identify which solution is the least acidic.

(1)

(ii) Deduce how the [H+] values compare in solutions of acids Y and Z.

(2)

(iii) Arrange the solutions of the three acids in decreasing order of electrical conductivity, starting with the greatest conductivity, giving a reason for your choice.

(2)

(Total 5 marks)

**31.** Define the terms *strong acid* and *weak acid*. Using hydrochloric and ethanoic acid as examples, write equations to show the dissociation of each acid in aqueous solution.

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(Total 4 marks)